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The al-ʿUlā–al-Wajh Survey Project: 2013 Reconnaissance Season

Zbigniew T. Fiema, Laïla Nehmé, Dhaifallah al-Talhi, and Will Kennedy

The reconnaissance season of the al-ʻUlā–al-Wajh Survey Project (UWSP) took place in October 5-8, 2013. The project is directed by Dr. Zbigniew T. Fiema, University of Helsinki, Finland, and it is affiliated with the Finnish Institute in the Middle East. The participants in the project included Dr. Laila Nehmé, CNRS Paris, Prof. Dhaifallah al-Talhi, University of Haʻil, and Mr. Khalid Hassan Al-Haiti, SCTA. Two archaeologists from other countries – Mr. Muhammad Matar al-Dhaheri from Abu Dhabi and Mr. Abdallah Muhammad al-Badi from Oman – have also participated in the fieldwork. The Project is most grateful to Dr. Ali al- Ghabban, Vice-President for Antiquities and Museums of the SCTA, for the permission to carry out the fieldwork, and to Dr. Jamal S. Omar, SCTA, for assistance and support. In al- ʿUlā, Mr. Mutlaq S. Al-Mutlaq and Mr. Abdulraḥmān Fāliḥ al-Balawī should be offered thanks for all assistance and the expertly guidance in the field. Prior to the fieldwork, substantial help was received from Dr. Jérémie Schiettecatte, CNRS Paris, who has shared with the project the database of the archaeological sites in the KSA and who has prepared a preliminary GIS analysis of the survey area. The UWSP is most grateful for his contribution.

The survey area (Plate 6.1a) is an approximate quadrant with its NE corner at al-ʿUlā (26º 36ʻ 28.16ʻʻ N; 37º 55ʻ 26.84ʻʻ E) and the SW corner at the Red Sea coast (25º 21ʻ10.52ʻʻ N; 36º 53ʻ 36.92ʻʻ E), which is located south of the outlet of the Wādī al-Ḥamḍ, and of Cape Kurkumah (Rās al-Jurayjīb). The UWSP is concerned with ancient land connections between the area of al-ʻUlā and the Red Sea littoral, the latter especially in the area of the modern city of al-Wajh (26º 14ʻ 2.17ʻʻ N; 36º 28ʻ 5.78ʻʻ E). In a straight line, this distance is ca. 180km.

However, the entire region between al-ʿUlā and al-Wajh is dominated by the range of the Hijazi mountains (between ca. 900 and 1600 m asl), which generally are oriented NW-SW and which culminate in the highest formation in the region being Jabal al-Ward at 2096 m asl. Typical for the region are valleys which cut across the mountains as well as the presence of large natural drainages, which could serve as convenient communication routes, of which the Wādī al-Jizl and the Wādī al-Ḥamḍ are the most significant ones (Plate 6.1b and 6.2a). The former, which can be accessed from the southern terminus of the Wādī al-ʿUlā, generally runs from SE to NW, toward Tabuk and thus can be only partially used in the communication with the Red Sea littoral. The Wādī al-Ḥamḍ enters the region from the SE, its course is joined by the Wādī al-Jizl, and then it runs almost due west toward the littoral plain. While both wadis run conveniently around the higher parts of the Hijazi mountains, both mark routes which are significantly longer

than any possible route which crosses the mountain range in a more straight line.

Previous Explorations

The archaeological exploration of the area, as described above, remains sketchy except for the area of the al-ʿUlā/Madāʾin Ṣāliḥ, which was already explored in the early 20th century by the French scholars Jaussen and Savignac (1914) resulting in a comprehensive description of these ancient settlements and their environs. Modern surveys of the northwestern and northern provinces of the Kingdom of Saudi Arabia took place in the beginning of the 1980s (Ingraham *et al*., 1981 and Gilmore *et al.,* 1982). The area between al-Wajh and al- ʿUlā/Madāʾin Ṣāliḥ was covered during these investigations although not intensively. This might partially be a reason that these surveys have failed to record any significant number of pre-Islamic sites. On the other hand, for example, the specialized surveys, which specifically targeted ancient mining sites, reported a number of sites along the Wādī al-Jizl, including numerous agricultural settlements and installations, predominantly Islamic but also of the pre-Islamic date (Kisnawi *et al.,* 1983).

Historical Background

Rather than recording all archaeological sites located within the area, as delineated above, the main goal of the al-ʿUlā–al-Wajh Survey Project is related to the patterns of ancient long- distance trade and communication routes in the Western Arabia and the Red Sea region.

Specifically, the project is concerned with the issue of the existence of an ancient route(s) connecting the area of al-ʿUlā, thus ultimately Madāʾin Ṣāliḥ (ancient Hegra), with the Red Sea coast, as well as it attempts to confirm the localization of Leuke Kome. The latter is known from the narrative of the Aelius Gallus' expedition to Arabia in 25 B.C., as narrated by Strabo (*Geography* 16.4.23-24) and from the Periplus Maris Erythraei (*Periplus* 19), where it is described as the seaport, commercial emporium and a customs post (see also Hackl *et al*., 2003: 564-566 and 606-615 for both texts and commentary).

The Nabataeans, the ancient Arab population who inhabited the territories of modern Jordan, Syria and Saudi Arabia, had largely monopolized a highly lucrative trade in aromatics during the Hellenistic and Roman periods, i.e., between the 4th century B.C. and the 3rd century A.D. (e.g., Bowersock 1983). Following the Nabataean expansion southward and the occupation of al-ʿUlā oasis with al-Khurayba settlement (capital of the Dedanite and later of the Lihyanite kingdom), a new settlement was established in Madāʾin Ṣāliḥ (ancient Hegra). This town had become the major Nabataean political center in the South and a significant commercial emporium on the so-called "Incense Route" – a complex system of interrelated routes and caravan tracks which generally connected the eastern Mediterranean with the incense-growing areas of South Arabia (see Potts 1988 for detailed discussion and presentation of routes). The Saudi and

Saudi-French excavations revealed that a large, walled settlement at Madāʾin Ṣāliḥ would presumably have existed as early as the 3rd century B.C. and at least until the 4th century A.D. (e.g., al-Talhi 1990, Nehmé 2011; Nehmé *et al*., 2006, 2010) and its growth must have benefitted from the caravan traffic.

Despite the annexation of the Nabataean kingdom by the Roman emperor Trajan in 106 A.D., there is no indication that the long-distance trade in aromatics would have ceased; at least not until the 3rd century A.D. (Fiema 2003). However, it is evident that the overland trade traffic faced a significant competition from the maritime trade traffic on the Red Sea, as associated with the development of the Egyptian seaports, such as Myos Hormos (Quseir al-Qadim) and Berenike (Arab Saleh), which was not only faster but also a cheaper means of transport in antiquity (Fiema 1996). The activities in the Egyptian seaports were related to specific seasonal patterns of navigation, as these also participated in the sea-borne commerce with India. On the other hand, the South Arabian commerce would, undoubtedly, have much benefitted from the combination of coastal sea-borne transport with the transhipment further north, using the incense route inland. Furthermore, with the documented Roman interest in the Red Sea area and its trade, the harbors on the Saudi littoral would have received much attention of the Romans, just as those on the Egyptian coast. In this context, the existence and location of the seaport at Leuke Kome is of capital importance. Ancient texts unequivocally state that Leuke Kome was a major element in such combined transshipment of merchandise from South Arabia. For example:

„From Leuke Kome camel traders travel safely and easily on the route to and from Petra, and they move in such numbers of men and camels that they resemble an army (Strabo, *Geography* 16.4.23)

"Loads of aromatics are conveyed from Leuke Kome to Petra" (Strabo, *Geography* 16.4.24)

"There is a harbour with a fort called Leuke Kome. From here there is a way inland leading to Petra and to Malichus the Nabataean king. This harbour also functions as a trade port for small craft that arrive loaded with freight from southern Arabia" (*Periplus* 19)

The location of Leuke Kome is much debated. Initially, some scholars have suggested the northwestern part of the Saudi littoral, where in the area of al-Bad' the existence of Nabataean sites in Maghayir Shu'ayb, Maqna and ʿAynunah imply the long-lasting occupation and probable maritime connection (Kirwan 1979; Bowersock 1983: 48; Sidebotham 1986: 124- 126; Young 1997; Graf 2000; Rihani 2004 for summary). Admittedly, ʿAynunah has a natural harbour and the surface ceramics indicate Nabataean-Roman activity in the 1st century B-C.– 1st

century A.D. (Ingraham *et al.,* 1981: 76-77). Other, less acknowledged, propositions along the western coast of Saudi Arabia included al- Haurå or Umm Lajj (Sprenger 1875: 28) and Yanbuʿ al-Bar (von Wissmann 1976: 466). However, other scholars convincingly argue that incense could have been shipped from South Arabia to somewhere in the area centered on the modern Saudi port of al-Wajh (Gatier and Salles 1988: 186-187; Cuvigny 2003: 28-29) and then, by overland route, to the largest Nabataean commercial center in the region, i.e., Hegra. In such case, ancient Leuke Kome might, in fact, have been located somewhere in a large bay located just south of al-Wajh. Strabo confirms that Leuke Kome was a natural harbour (*hormos*) and so the bay south of al-Wajh would have provided a sufficiently large anchorage to accommodate the fleet of 120 large cargo ships used by Aelius Gallus in his expedition. Most recently, a detailed examination of the distances preserved in ancient sources, combined with the features of the natural terrain and the comparative analysis of the location of ʿAynunah convincingly demonstrated that Leuke Kome must definitely have been located further south than ʿAynunah and that the area of al-Wajh is the optimal location for that ancient seaport (Nappo 2010).

In the context of the maritime trade and inland connections, the area of al-Wajh is of further interest, especially in relation to Egra Kome. This location, also mentioned by Strabo as the place where Aelius Gallus embarked on the return journey to Egypt, is described as being in the Nabataean territory and by the Red Sea. The identification of Egra Kome is even more difficult than of Leuke Kome, and it largely depends on the opinion where the latter should be located. Sidebotham (1986: 126) proposed that Egra Kome should be located somewhere south of Leuke Kome (ʿAynunah) while Musil (1926: 299-301) preferred the location in the environs of al-Wajh. Other scholars (e.g., Hackl *et al* (2003: 615) postulated Egra Kome as the harbor of Hegra (Madāʾin Ṣāliḥ), located in the environs of al-Wajh, in the delta of the Wādī al-Ḥamḍ. If Egra Kome was indeed a harbor situated in the environs of modern al- Wajh, just like Leuke Kome, this would create an issue of two seaports located nearby, a rather unlikely scenario. The recent proposal advocating that Strabo confused the embarkation point of Aelius Gallus with the city - Hegra (Madāʾin Ṣāliḥ) - where he stopped during his withdrawal from South Arabia (Nappo 2010: 340-341), appears most reasonable, especially since it confirms the distance between Egra and Myos Hormos, as specified byStrabo.

Notably, A. al-Ghabban has recently suggested the identification of Egra Kome with extant remains on Cape Kurkumah, ca. 40 km south of al-Wajh. The recovered surface objects seem to have come from the locality known as al-Qusayr, ca 16 km NE of Cape of Kurkumah, by the outlet of the Wādī al-Ḥamḍ, which preserves remains of the Nabataeaen temple and wells (al-Ghabban 1993; Nehmé 2009: 41).

The presence of Nabataean remains should indicate that the environs of al-Wajh may indeed be crucial in the location of an ancient seaport in the central part of the Saudi littoral. Finally and more importantly, if Leuke Kome is indeed located somewhere in the area of al-Wajh, and, as the ancient sources indicate, the South Arabian produce was unloaded there for further transshipment overland, it would be logical to expect a caravan route(s) leading from the area of al-Wajh to Hegra (Madāʾin Ṣāliḥ), presumably through al-ʿUlā.

Project's Methods and Objectives

In practical terms the UWSP intends to locate a route(s) between the areas of al-ʿUlā and al- Wajh, which:

-with regard to the terrain and climate could have served to allow passage of a considerable number of humans and animals

-with regard to availability of water and animal fodder, it could have sustained such number of humans and animals during the passage which would have lasted several days

-displays unambiguous traces of ancient usage of such passage.

Secondly, and in close connection with the above, the project intends to investigate the environs of al-Wajh, especially the coastal plain area between the modern city and the Cape of Kurkumah (Rās al-Jurayjīb), in search of other archaeological remains which may potentially shed light on the importance of the area in antiquity.

The preparatory stage of the project required the research including the acquaintance with the relevant scholarly literature and the topographical maps of the region, the examination of satellite imagery as well as the analysis of potentially most cost-benefit routes using the Geographical Information Systems (GIS). Currently, the project is developing an electronic database for recording sites, in which it received considerable assistance from L. Nehmé and Schiettecatte.

Once the most suitable routes are identified with regard to the landscape and terrain the fieldwork will verify their preference and potential use in antiquity. Ideally, the latter should be distinguished through the extant remains of settlements (villages, farmhouses, campsites, cultic sites), traces of ancient cultivation (including wells and watering sites), scatters of ceramics and lithics, petroglyphs (including rock art and *wusum*-tribal marks), installations (enclosures, etc..) and the epigraphic sites featuring inscriptions of all time-periods.

It is, however, already apparent, following the 2013 reconnaissance season, that the

preservation of such archaeological sites is seriously impacted by the modern development (construction of roads) and the natural conditions. Practically, it cannot be expected that any sites located on or near wadi beds would have survived intact due to the heavy accummulation of colluvial and alluvial material. A somewhat better chance of survival may be experienced by sites located on the slopes of the wadis or even on top of escarpments, generally on the higher ground and mountain passes. Even there the erosion factor is significant. Probably the best and unambiguous evidence concerning the ancient use of a specific communication route are the inscriptions left on the faces of rocks. Similarly, in addition to the identification of main water catchment areas, it is important to locate remains of ancient wells, reservoirs and cisterns, some of which might have been in use until recent times. This brings forth the importance of local informants who may be familiar with the locations of epigraphic sites and old water sources, or are still aware of old travel routes used by their ancestors.

Least-Cost Path Calculations/ Cost-Distance Analysis

With the introduction of GIS-based methods to archaeological studies, the calculation of the so-called least-cost paths (LCP) has become increasingly practical within the discipline by becoming a realistic survey stategy-building device. The method not only aims to reconstruct the possible course of ancient routes and pathways, but it also renders information on overall ancient landuse, i.e. the avoidance of difficult streams or certain terrain types etc. (Herzog and Posluschny 2011: 236-237; Posluschny 2012: 115). LCP-calculations assist the modeling of the infrastructure and spatial organization of ancient landscapes in terms of transportation velocity, security and the connectivity of different sites (Posluschny 2012: 115). However, the method fails to calculate certain social factors such as territorial claims, taboo zones or personal preferences and it cannot take missing archaeological data into account (Herzog and Posluschny 2011: 237; Posluschny 2012: 115).

Mostly, these calculations are based on slope values that are derived from a digital elevation model (DEM) of the modern landscape. Different GIS software packages with various equations are able to calculate optimal paths from two pre-defined points. The optimal path can either be measured by the energy needed to cross a landscape by foot, i.e., calories etc., or simply by time (Posluschny 2012: 115).

In order to receive a preliminary impression of:

(a) the shortest (=quickest) route (Plate 6.2a, brown route) and
(b) the most comfortable way from al-Ula to al-Wajh (Plate 6.2a, beige-yellowroute)

a first LCP-calculation with ESRI´s ArcInfo

10.1 was applied.[1]The DEM used for the calculation has a resolution of 30m and was supplied by the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA).[2]In contrast to option (a), option (b) not only calculates the least accumulative cost for crossing the given landscape, but also takes into account „[…] the actual surface distance that must be traveled and […] the horizontal and vertical factors influencing the total cost of moving from one location to another."[3] These horizontal and vertical factors are also defined as *friction* values or factors.

(Plate 6.2b) represents the cost function curve of the friction factor (beige-yellow line) depending on the slope values (brown line). The friction curve is measured in energy and the slope values in degrees. Whereas the slope curve rises in a linear fashion, the friction curve runs below the slope line and crosses it at 33°. The friction values rise significantly higher than the slope degree from this point onward. This means that the calculated route based on the friction values avoids slope values higher than 33° since it is too costly. The calculated route based on the friction values is represented in (Plate 6.2a) by the beige-yellow line, whereas the brown route represents the minimum accumulative travel cost depending on the slope values only.

1 The algorithm used to calculate the friction values is based on the walking pace of a pedestrian in a low-mountain environment: [(slope value^2 x 0,031)-(slope value x 0,025)]+1= friction value of a pixel.

Thus the shortest way (brown in color), as implied by the GIS analysis, is represented by the course almost due west from al-ʿUlā, across the high mountainous plateau of Ḥarrat al- ʿUwayriḍ, then, partially utilizing the Wādī al-Jizl, continuing westward on the course which largely follows the modern road to al-Balāṭah, Badā, and Abū al-Qizāz, passing by the road to al-Kurr, finally entering the coastal plan to the NE of al-Wajh. The most comfortable but considerably longer route (beige-yellow) leads in southeasterly direction from the Wādī al- ʿUlā, then following the Wādī al-Jizl to its confluence with the largest natural drainage in the region, i.e. the Wādī al-Ḥamḍ, and continuing along this wadi, finally it enters the coastal plain east of the Cape Kurkumah (Plate 6.2a, 6.3a). Future endeavors of the UWSP will include further experimentation with LCP-calculations applying different algorithms and comparing the calculated routes with the survey results and setting them into context with the collected archaeological data.

The 2013 Reconnaissance

Due to the limited period of time available for the fieldwork in 2013, it was decided to devote the time to a general reconnaissance rather than a systematic survey season, primarily in order to get acquainted with the area and its specifics. In this framework, the urgent task was to ascertain the existence of other possible routes, shorter and more direct than these implied by the GIS analysis. The examination of the maps and the satellite imagery revealed the existence of

intramontane wadis and mountain passes which might, theoretically, have allowed in the past the movement of humans and animals across the mountain range. In fact, the suitability of some of such routes is exemplified by the fact that currently these are asphalt-paved roads.

At any rate, the UWSP has followed two of such routes (#1 and 2) but also briefly investigated some parts of the route indicated by the GIS analysis (Route 3). The beginning of all three routes is marked by the asphalted road al-ʿUlā –al Wajh which follows the Wādī al- ʿUlā. At the end of this wadi, the road enters the wide basin of the Wādī al-Jizl. Notably, several kms northwest of that point is al- Mābiyāt, an important Early Islamic site.

Route 1

At first, this route (Plate 6.3b) follows the course of the Wādī Fuḍalā - a wide and convenient natural drainage, currently with the asphalted road, which runs SW toward Jaydah. Near this settlement, there is a well called Bīr as-Sṭayḥ dug into the rock without masonry lining (Plate 6.4a), which seems to have been utilized until recently. Two presumably old wells are also located in the settlement of Jaydah. From the area of Jaydah, the road follows a gradual ascent, on a partially human-made escarpment, and then continues steeply down to the Wādī al-Kharrār, turning to NW to al-Kharrār (Plate 6.4b). Near al-Kharrār, there is a wadi with some rock-carvings of animals (Plate 6.4c) and a relatively modern Arabic inscription at a place locally called al-Khulkhul. Further up the same wadi is located another well which, according to the local informants, was abandoned about 30 years ago (Plate 6.4d). Near al-Kharrār, the road branches off. The southern branch continues to al-Khurbā, then to al-Manjūr, along the Wādī al-Qudayr. Once the mountainous range is left behind, the landscape from al-Kharrār to al- Manjūr changes into a gradually opening, alluvial and fan-shaped, low ground characterized by a stony surface and a series of low hills with accessible slopes and small lateral wadis (Plate 6.4e). But for the travellers proceeding inland from the coast the mountains must have been perceived as a considerable „barrier“ (Plate 6.4f; also compare with Plate 7.9a). Any route leading SW from al-Manjūr enters the wide drainage of the Wādī al-Ḥamḍ and then the Red Sea littoral. The other branch road near al-Kharrār proceeds along the Wādī al-Kharrār to the village of as-Sudayd, then, south of Jabal al-Ward, it continues NW toward al-Kurr.

Route 2

This route (Plate 6.5a) utilizes the Wādī Tharī which runs E-W. Ca. 22 km west from the intersection with the Wādī Fuḍalā road, there is another one on the main al-ʿUlā–al-Wajh road, leading SW toward al-Qarm, al-Farash, and al-Ward, which crosses the Wādī Tharī running E-W. The wadi bed is made of deep alluvial deposits, mostly consisting of small and often sharp stones, and the surrounding mountains are often steep (Plate 6.5b), on the

northern side becoming almost vertical cliffs. It was possible to ascertain that there is no western exit from the Wādī Tharī, as it is considerably narrowed by huge boulders and ultimately terminates in a ca. 5 m high barrier with a waterfall. However, before reaching the wadi end, one can turn off on a SW-leading wadi –the Wādī Qamīlah. Along this route, a site of an old encampment with several cairns and oval grave pits lined with stones was noted (Plate 6.6 a-b), and also a well (Plate 6.6c). The route continues toward the mountainous pass of Ṭayyib ism, which appears to be the only pass allowing the access to the valley of as-Sudayd and al-Kharrār (Plate 6.6c; see also Route 1). Currently, the upper part of the pass is alphalted but in a very poor state of preservation largely preventing the descent which is very steep. However, a pass is reported to have been used in the past as a pathway for camels (hence Jāddat Ṭayyib ism).

Route 3

This route (Plate 6.7a) partially follows the shortest route indicated by the GIS analysis. Initially, the latter would require to ascend the mountainous plateau of Ḥarrat al-ʿUwayriḍ (between 700 and 1200 m asl) from al-ʿUlā, in order to reach the Wādī al-Jizl further west. The local informants indicated the possibility of the existence of such an ascent, but the brief investigations carried out there were not successful. Therefore, the Wādī al-Jizl was accessed through the main al-ʿUlā –al-Wajh asphalted road. The wadi is a flat expanse, ca 2-4 km wide at places. It is an excellent watershed and catchment area, as rainwater often stays as long as a year in the side gorges and small wadis. The wadi bed is mostly sandy, with occasional areas of gravel and cobblestones but generally easy for large movement of animals (Plate 6.7b).

Although no inscriptions or ancient remains were noted, such may exist on the generally gentle slopes facing the wadi. As the wadi ulimately turns north toward Tabuk, the UWSP team turned back to the main al-ʿUlā–al-Wajh road continuing through al-Balāṭah, Badā, and Abū al-Qizāz then turning south to al-Kurr. The local informant mentioned the existence of an ancient track leading to the coast and passing by the place called az-Zuraybah, which is probably on the Egyptian pilgrimage road since there is supposedly a *qalʿah* there. Notably, from al-Kurr and Badā one can also travel to al-Ward by the track passing through an-Najīl and Abū Ḥadīdah.

Assessment

Since neither the archaeological remains nor epigrahic sites were found and recorded during the reconnaissance, the vital information allowing the assessment and the development of the future survey strategy concerns the topography and natural conditions prevailing along these routes. Important is the existence of routes alternative to these indicated by the GIS analysis, which might potentially have been used in antiquity (Plate 6.8a). Both Route 1 and Route 2 are shorter and more direct communication

means between the area of al-ʿUlā and the Red Sea, although these must traverse considerable mountainous terrain (Plate 6.8b, Plate 7.9a).

Route 1 appears promising in terms of further investigations despite a relatively steep ascent and the following sharp descent to the Wādī al-Kharrār. There are definitely natural water sources along this route although this issue will require further investigation. Route 2 is probably the shortest and most direct, although also featuring a difficult ascent/ descent (at Ṭayyib ism). The major problem with travelling along the Wādī Tharī is a predominantly stony ground which would definitely be very difficult for pack animals. Camels used to a sandy ground would find sharp rock-strewn wadi beds difficult and potentially hurting (for discussion, see

Gauthier-Pilters and Dagg, 1981: 102-3). Traversing such terrain would be possible for locally raised animals accustomed to the rocky terrain although it also is generally acknowledged that heavily laden camels do not perform well in the mountainous conditions (e.g., Musil 1928: 95).

On the other hand, Route 3, partially utilizing the Wādī al-Jizl, is definitely longer by using a detour around the highest mountainous range in the region, yet it also possesses its advantages. At least in the Wādī al-Jizl, water is probably more easily available throughout the year there than along other routes. This is also clearly indicative in terms of the flora existent there which may be utilized as camel fodder. Generally, camels consume several kinds of bushes and trees: *ritm*, which is the bush available in most of wadis. They also eat the seeds (called *al-ballah*) of two trees: *as-siyāl* (Plate 7.9b) and *as-samrah* (Plate 7.9c) and the leaves of the latter, especially the small green leaves which appear at the top of the tree. These two trees apparently have the advantage of providing seeds twice a year, contrary to the *ritm*,

which has them only once a year. At this point of time, it is apparent that the Wādī al-Jizl possesses more of these natural resources than, for example, the Wādī Tharī, although their existence outside the Wādī al-Jizl and along Route 3 cannot be fully ascertained.

While Routes 1 and 2 may indeed be the shortest connections between al-ʿUlā and al-Wajh, one needs to bear in mind the specifics of large-scale caravan traffic (e.g., see Seland 2014), including the presence of large numbers of camels, which need fodder and water and the preference of laden camels to move in a non-mountainous terrain. Therefore, the longest route suggested by GIS analysis (Plate 5.2a, beige-yellow), which largely follows the Wādī al-Ḥamḍ – a wide and relatively flat terrain – may indeed be most convenient for large camel caravans and much more comfortable for traffic than the shorter but partly also more difficult Routes 1 and 2. The next season of the UWSP fieldwork will concentrate on the Wādī al-Ḥamḍ route, specifically investigating its outlet into the coastal plain and including the site ofal-Qusayr.

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أ. خريطة الموقع

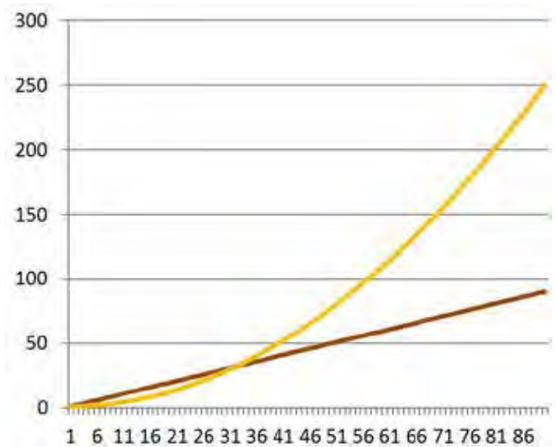
a. The map of the UWSP area.

ب. يوضح ارتفاعات الدروب والمسارات بصورة ثلاثية الأبعاد ويظهر الدرب١ باللون الأزرق والدرب٢ بالأحمر والدرب٣ بالأخضر وأقصر المسالك من مدائن صالح إلى الوجه

b. The 3D digital elevation model (based on ArcScene) with the overlaid Route 1 (blue), 2 (red), 3 (green) and the least-cost paths from Madāʾin Ṣāliḥ to al-Wajh: the calculated least- cost paths are based on minimum time and energy expenditure (brown) and the minimum energy expenditure only (beige-yellow) (by W. Kennedy).

أ. يوضح ارتفاعات تضاريس المنطقة وأقصر الدروب

a. Topographical contour map of the USWP area also showing the least-cost paths: minimum time and energy expenditure (brown) and the minimum energy expenditure only (beige-yellow) (by J. Schiettecatte and W. Kennedy).



ب. منحنى معامل الاحتكاك وفقاً لقيم الانحدار

b. The cost function curve of the friction factor (beige-yellow line) depending on the slope values (brown line) (by J. Schiettecatte).

أ. خريطة رأس كركمة ومفيض وادي الحمض
a. Map of the Cape Kurkumah area with the outlet of the Wādī al-Ḥamḍ.

ب. الدرب ١
b. Route 1 (by J. Schiettecatte and W. Kennedy).

أ. بئر السطيح.
a. The well in the location of Bīr as-Sṭayḥ (by L. Nehmé).

ب. منحدر وادي الخرار.
b. The descent to the Wādī al-Kharrār (by Z. T. Fiema).

ج. رسوم حيوانات في الخلخل.
c. Rock-carvings of animals at al-Khulkhul (by Z. T. Fiema).

د. بئر في الخلخل(في الوسط).
d. The well at al-Khulkhul (in the center) (by L. Nehmé).

هـ. منطقة وادي القدير.
e. The lowlands of the Wādī al-Qudayr area (by Z. T. Fiema).

و. جبال كما تبدو من وادي القدير.
f. The mountainous „barrier“ as seen from the lowlands of the Wādī al-Qudayr (by Z. T. Fiema).

أ . الدرب ٢ .
a. Route 2 (by J. Schiettecatte and W. Kennedy).

ب. ناحية من وادي ثاري.
b. The landscape of the Wādī Tharī (by L. Nehmé).

ب. قبور بالمنزل القديم.
b. Grave pits on the site of old encampment (by Z. T. Fiema).

أ . موقع منزل قديم وقبور.
a. The site of old encampment with graves (by L. Nehmé).

د . درب جبلي عبر طيب الاسم ويبدو وادي الخرار.
d. The mountainous pass of Ṭayyib ism, with the view into the al-Kharrār Valley (by L. Nehmé).

ج. بئر بوادي قميلة.
c. The well in the Wādī Qamīlah (by Z. T. Fiema).

أ. درب ٣.

a. Route 3 (by J. Schiettecatte and W. Kennedy).

ب. منظر من وادي الجزل.

b. The landscape of the Wādī al- Jizl (by L. Nehmé).

أ. الدروب رقم ١ بالأزرق ورقم ٢ بالأحمر ورقم٣ بالأخضر وأقصر المسارات وقتاً وكلفة باللون البني والأصفر البيج.

a. Routes 1 (blue), 2 (red), and 3 (green) overlaid on the 3D digital elevation model (based on Google Earth), also showing least-cost paths: minimum time and energy expenditure (brown) and the minimum energy expenditure only (beige-yellow). View from S (by J. Schiettecatte and W.Kennedy).

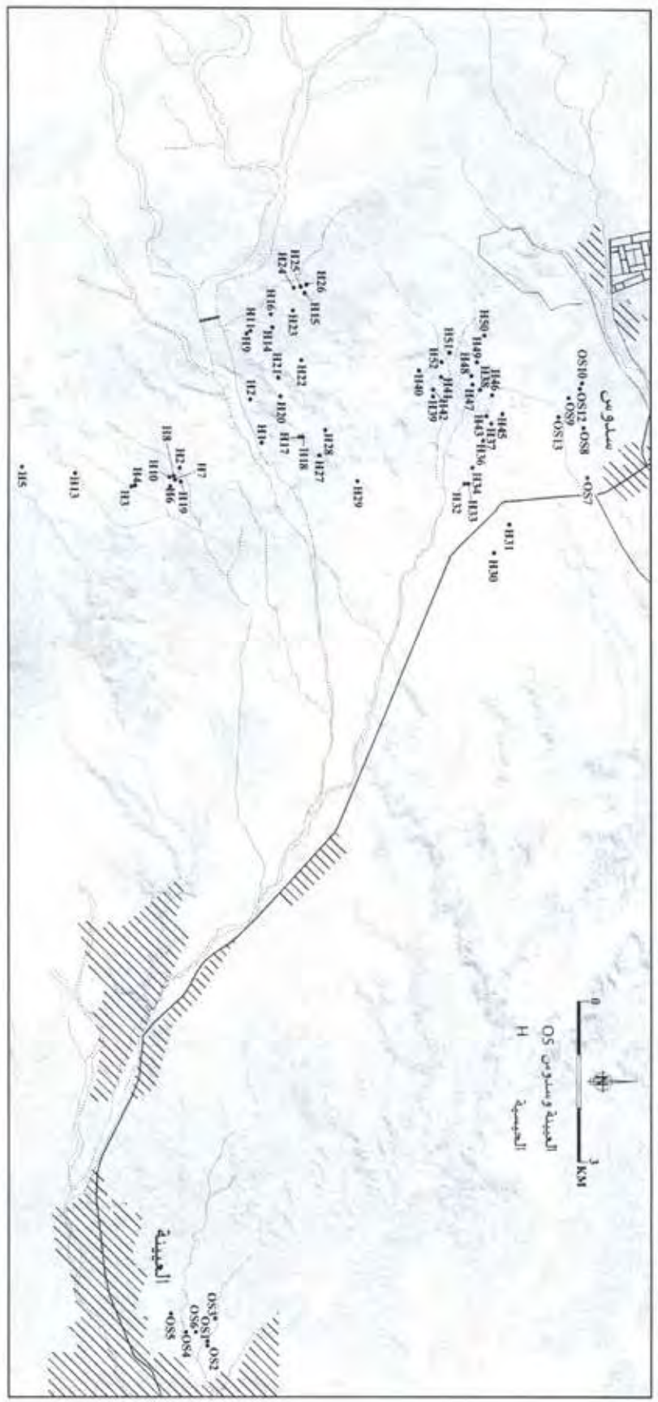
ب. الدروب : رقم١ بالأزرق، ورقم٢ بالأحمر، ورقم٣ بالأخضر بالتصوير ثلاثي الأبعاد.

b. Routes 1 (blue), 2 (red), and 3 (green) overlaid on the 3D digital elevation model (based on Google Earth). View from N (by W. Kennedy).

أ. المسارات رقم١ بالأزرق ورقم٢ بالأحمر ورقم٣ بالأخضر بالتصوير ثلاثي الأبعاد وتوضح أقصرها كلفة ووقتاً.
a. Routes 1 (blue), 2 (red), and 3 (green) overlaid on the 3D digital elevation model (based on Google Earth), also showing least-cost paths: minimum time and energy expenditure (brown) and the minimum energy expenditure only (beige-yellow). View from S (by J. Schiettecatte and W. Kennedy).

ب. شجرة السيّال.
b. The *as-siyāl* tree (by L. Nehmé).

ج. شجرة السمر.
c. The *as-samrah* tree (by L. Nehmé).



المواقع المكتشفة في العينة وسدوس والحيسية.
Sites discovered in Al-Uyayna, Sdaws and Haisiyya.